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ANTS AS BENEFICIAL INSECTICIDES.

By REV. DR. H. C. MCCOOK.

Through the courtesy of Rev. H. Corbett, a missionary of the American Presbyterian Board, at Cheefoo, China, I received a copy of the "North-China Herald," of April 4, 1882, containing an article by Dr. Magowan, of Wenchow, on the "Utilization of Ants as Grub-Destroyers in China." From this paper I quote the following sentences:

"Accounts of the depredations of the coccids on the orange-trees of Florida, induce me to publish a brief account of the employment by the Chinese of ants as insecticides. In many parts of the province of Canton, where, says a Chinese writer, cereals cannot be profitably cultivated, the land is devoted to the cultivation of orange-trees, which, being subject to devastation from worms, require to be protected in a peculiar manner, that is, by importing ants from neighboring hills for the destruction of the dreaded parasite. The orangeries themselves supply ants which prey upon the enemy of the orange, but not in sufficient numbers; and resort is had to hill-people, who, throughout the summer and winter find the nests suspended from branches of bamboo and various trees. There are two varieties of ants, red and yellow, whose nests resemble cotton-bags. The 'orange-ant feeders' are provided with pig or goat bladders, which are baited inside with lard. The orifices of these they apply to the entrance of nests, when the ants enter the bags and become a marketable commodity at the orangeries. Orange-trees are colonized by depositing the ants on their upper branches, and to enable them to pass from tree to tree, all the trees of an orchard are connected by bamboo rods.

"Is the orange the only plant thus susceptible of protection from parasitic pests? Are these the only species of ants that are capable of utilization as insecticides? Indubitably not; and certainly entomologists and agriculturalists would do well to institute experiments with a view to further discovery in this line of research."

I propose to consider whether the suggestion here raised is entitled to serious attention by economic entomologists in the United States, as likely to lead to valuable practical results.

I. In the first place it might be asked, *Are the domicile habits of ants favorable?* Ants possessing the habit of the China emmets referred to by Dr. Magowan are comparatively rare, certainly not many are known to science. Mr. F. Smith, in his Catalogue of Hymenopterous Insects in the British Museum,¹ gives figures of several fibrous nests made by arboreal species of ants, *Crematogaster (Pachycondyla) montezumia*, from Mexico, *Polyrhachis textor*, from Malacca, *Formica gibbosa*, India, and *Crematogaster arboreus*, from Port Natal. One of these, it will be observed, is a North American species, the only one indeed of which I have any knowledge. An Australian species, *Crematogaster læviceps*,² builds a pensile nest somewhat in the fashion of our hornet, upon trees. It contains a labyrinth of curved galleries and cells centering upon the interior. *Formica bispinosa*, of Cayenne, forms a nest of cottony matter from the capsules of Bombax.³ In Brazil, this species, the *Polyrhachis bispinosus*, is popularly known as the "Negro-head Ant," the globular nest, covered on the exterior with little projections, being suggestive of close wooly hair. Smith says that the material of which it forms its nest, furnishes an article of commerce used as tinder, for lighting cigars, etc.⁴ *Myrmica kirbii*, an India species described by Lieut. Col. W. H. Sykes,⁵ which is apparently a species of *Crematogaster*, makes a formicary in the branches of trees out of the droppings of cows. These it spreads in thin, flaky, overlapping folia, like shingles or tiles. A dome-like roof covers the summit in an unbroken sheet, like a skull-cap on a man's head. The interior consists of a multitude of irregular cells, formed of the same material as the exterior. The "Green Ant," *Ecophylla virescens*, builds an arboreal nest of dead leaves, from which it often drops down in be vies upon travelers, very much to their discomfort. The nest is about eight inches in diameter, and is made of a leaf-pulp—as the hornet's nest is of a pulp of wood-fibre—and is hung among the thickest foliage, being sustained not only by the branches, but by the leaves which are wrought into the nest, and in parts project from the outer wall. Mr. Foxcroft discovered an

¹ Part vi, Formicidæ, Plates I, II, XIV.

² Smith, Catal. Brit. Mus., vol. 15, Formicidæ, p. 138.

³ Lubbock, 1882, "Ants, Bees and Wasps," p. 24.

⁴ Trans. Entomol. Soc., Lond., Ser. iii, vol. i, p. 32, 1862.

⁵ Trans. Entomol. Soc., Lond., *id.*, p. 101.

African species of *Ecophylla*, which, when disturbed, swarmed in excited legions upon the outside of their papery domicile, against which they pattered so vigorously, as they moved, that the observer thought the rain was falling upon the leaves above.¹

These are all exotic species, and I know of no American (U. S.) arboreal ants except those, like the various species of *Camponotus*, for example—the Carpenter ant—that live within the excavated wood. Any protection to the fruit wrought by these would be neutralized by the injury done the tree itself. Certain species of ants have also been reported as dwelling in the hollow interior of the spines that grow upon some of our thorny trees, like those referred to by M. Ernest André in his admirable work now going through press.²

Mr. W. H. Patton has described an indigenous species, *Stenamma gallarum*, as inhabiting a gall upon a dead but unbroken stock of golden rod.³

Ants are indeed often seen in great numbers upon trees, and moving in columns up and down the trunk and along the branches; but such are engaged in seeking food from aphides, coccids, galls, etc., and usually have their domiciles elsewhere, for the most part underground.

Mr. Smith describes a species (*Pseudomyrma modesta*), collected in Panama, which nests in the spines of a species of *Acacia*. The spines are three inches long, and the entrance to the formicary is a small hole gnawed near the point. There are no cells within, and this is probably (as the similar cases alluded to may be), simply an example of “squatter sovereignty.”⁴

We do have indigenous ants with the habit of constructing nests of leaf-pulp, in the manner of the China species, as for example *Atta fervens* Say, and *Atta septentrionalis* McCook, heretofore described in these Proceedings. *Atta fervens*,⁵ the Leaf-cutting or Parasol ant strips the leaves of various trees, reduces them to pulp, and forms nests rudely resembling those of the hornet. These nests, however, are underground, and not upon trees. As I have seen them in Texas hanging to the roots of an immense

¹ Wood, “Homes without Hands,” p. 270-3.

² “Species des Formicides d’Europe,” p. 52.

³ Amer. Naturalist, Feb., 1879, p. 126.

⁴ Trans. Ento. Soc. London, vol. i, ser. 3, p. 33.

⁵ Proceed. Acad. Nat. Sci. Philadelphia, 1879, p. 33.

live oak-tree, or built up from the floor, or attached to the roof of their large subterranean caves, they quite resembled the pensile nests of the tree-ants as described by various writers. *Atta septentrionalis*¹ is a New Jersey species, and builds out of the leaves of pine nests which are little models—almost toy-like in their minute mimicry—of the Texas species. These, too, are underground, and although they have the requisite ability as to nest-making, the problem of domesticating them in the tree-tops could hardly be solved, even by an economic entomologist. It may be concluded, therefore, that if a domicile in the trees, as with the China species, be a necessary condition, we have no indigenous species upon which to experiment, either to utilize or develop a habit that will make ants so highly beneficial as insecticides as to justify any dependence upon them as protectors of fruits.

II. In the second place we may ask: *Is the food-habit of ants favorable?* Undoubtedly ants are insectivorous, or carnivorous, rather. Their food-supply is largely drawn from insects yielding sweet excretions or secretions; from the nectar and sugary exudations of plants, from fruits, from the oils of nuts, seeds, etc. They are also largely scavengers. Dead insects and animals of all kinds, refuse of many sorts afford them nutrition, but they do not limit their insectivorous tastes to mere scavenger work: they also prey upon living insects. This is true of our indigenous ant-fauna, although we have no such wholesale insecticides as the famous Eciton or Driver ant of Africa and South America, whose raiding columns clear out every living insect within their broad sweep.² I have seen the Mound-making ants of the Alleghenies (*Formica exsectoides*) preying upon our native Termite or White ant, *Termes flavipes*,³ when the nests of this insect had been uncovered by turning up stones upon the mountains in search of specimens. It was surprising to note how quickly the Formicas appeared on the scene, seeming to dart out from behind every blade of grass, stick and stone, and leaping into the galleries that threaded the flat pit of the stone, seized with avidity the soft white *Termes* and made off with their prey. These ants and many

¹ Proceed. Acad. Nat. Sci. Philada., 1880, p. 359.

² See a full account in Belt's "Naturalist in Nicaragua," p. 17, seq., and "Naturalist on the Amazons," vol. ii, p. 350.

³ Proceed. Acad. Nat. Sci. Philada., 1879, p. 154.

others have been seen capturing flies,¹ even on the wing, and frequently bringing home to their nests various insects, still living or recently killed.

So also the Agricultural ants of Texas,² have been seen after a shower to break suddenly out of their formicary, scatter throughout the foliage and return with immense numbers of living insects beaten down by the hard rain.

Forel³ says that throughout the bounds of an ant-city of *Formica exsecta*, in Switzerland, covering many acres, he was not able to discover any other species of ant except a few nests of *Tetramorium caespitum*, who owed their exemption to their superior agility. This is true in some measure of the allied *F. exsectoides*, in our mountains and the New Jersey barrens. In addition, it may be stated that ants are veritable cannibals, destroying and feeding upon not only individuals of their own family, but those of their own species. In the same connection may be mentioned a custom of American Indians to put furs and blankets infested by insects near the mounds of the Occident ant, in order to have them cleaned out by the insectivorous emmets.⁴ So far, therefore, as the mere food habit is concerned, it is favorable to the idea of utilizing certain species of ants as insecticides.

III. A *third* question may be raised, viz.: *Do our ants exhibit in nature any special insectivorous habits that would make them natural protectors of crops?* This question has been considered at some length by the Agricultural Department of the United States Government in the matter of the cotton crops. In a report on Ants, prepared at the request of that department,⁵ the writer reviewed the testimony gathered from many and widely separated sections as to the friendly offices of ants in destroying the eggs and larva of the cotton-worm. My opinion then was that, on the whole, those offices would hardly have an important commercial value, although to a certain extent beneficial. Many of the practical observers from whom information was collected, spoke highly of the services of the ants, especially of one, "the Cotton

¹ Mound-making Ants of the Alleghenies, p. 259.

² Agricultural Ants of Texas, p. 108.

³ Les Fourmes de la Suisse, p. 207.

⁴ Honey Ants of the Garden of the gods, and Occident Ants of the American Plains, p. 151.

⁵ Comstock's Report upon Cotton Insects, 1879, p. 181, seq.

Ant," *Solenopsis xyloni* McCook. These ants were particularly effective against the eggs, but attacked the larva also. So good an observer as Mr. Trelease ventures the opinion that ants are probably among the most important enemies of the cotton-caterpillar. One observer went so far as to think that the ants would ultimately destroy the cotton-worm, should it prove to be indigenous rather than of foreign origin.

All the ants considered in the above-named report are mining ants, and would therefore not be available for such uses as the species of the Chinese orangeries. There appears to be no good reason, however, why they might not be useful on the orange-trees of Florida, to which State some of them are native. But it would be a necessary condition, I think, that the ants should exist in such vast numbers as to compel, under the stimulus of hunger, a thorough canvassing of every neighboring object that might shelter available prey. The value of the Chinese Orange ants appears to turn upon such conditions, viz.: their limitation to tree surfaces as a foraging field, and their vast numbers. In short, a limited supply of food and an immense demand for it, constrain the ants to the most diligent garnering and careful gleaning. On the whole there is little hope that these conditions can be met by artificial domestication of American ant fauna.

IV. *Would it be practicable to domesticate the Chinese species in America?* In answering this question I can venture no opinion as to whether it would repay orange-growers, but as a matter of experiment, merely, I think it might be practicable. Certainly some of our species are widely distributed, and probably imported. That universal pest of the housekeeper, the little red ant, *Monomorium pharaonis*, is probably a foreigner; at all events is a cosmopolite, being found in houses all over the world. Mr. Frederick Smith had reason to believe that it is a native of Brazil, whence it has been distributed in merchandise.¹ *Formica rufa*, of the Rocky Mountains, and *F. exsectoides*, of the Alleghenies, differ little from the European *F. rufa* and *F. exsecta*. *F. sanguinea*, the Red Slavemaker, is common to both continents, and our Shining Slavemaker, *Polyergus lucidus*, differs very little from the European *P. rufescens*. The Pavement ant, *Tetramorium cæspitum*, inhabits both hemispheres. *Pheidole megacephala*, which I have found in the neighborhood of Philadelphia,

¹ Trans. Ento. Soc., London, vol. i, 1862, p. 33.

is distributed throughout the tropical and sub-tropical regions of the entire world.¹

In view of these facts, there is a probability, at least, that the tree-ants of China might be introduced and domesticated. Whether *such* "Chinese migration" would be encouraged by an American Congress might have to be considered! And perhaps it would require the patience and skill of the Chinese *men* to successfully domesticate Chinese *ants*—could that be done at all.

In the same connection it may be said that some of our indigenous species have a remarkable elasticity of organism by which they are adapted to the widely varying climatic and geographical conditions of our country. For example, both the Red and Shining Slavemakers which inhabit the Atlantic coast, I have found in the Garden of the gods, Colorado.² Several species of the Carpenter ants are distributed throughout our forests from Maine to California, notably *Camponotus pennsylvanicus*, which I have found not only in our Eastern mountains, but in sub-tropical Texas. Prof. Aug. Forel³ has examined specimens from New Orleans, and California, as well as from China, Japan and Siberia. Throughout all these regions it has precisely the same habits as described by the writer.⁴ *Formica fusca*, which so often appears as a domestic ally or "slave" of the kidnapping species, is widely distributed over our continent, and is substantially identical with the species of the same name found nearly everywhere in Europe.

On the other hand, some ants have well-marked geographical limits which have not yet been overcome by natural movements. The Occident ant (*Pogonomyrmex occidentalis*), I have traced⁵ approximately within a range of 13° latitude, say from 45° N. to 32° N.; and of 21° longitude, that is, from Brookville, Kansas, to Reno, at the base of the Sierra Nevada, 1622 miles west of the

¹ Catalogue des Formicides d'Europe, by Forel & Emory. Mittheilungen der Schweiz. Entom. Gesellsch., Bd. 5, Heft 8. Schaffhausen, Alexander Gelser, 1879.

² McCook, "The Shining Slavemakers," Proceed. Acad. Nat. Sci., Phila., 1880, p. 376, seq.

³ Forel, "Etudes Myrmécologiques En.," 1879. Bull. Soc. Vaud. Sc. Nat. xvi, 81, p. 858.

⁴ Trans. American Entom. Soc., vol. v, 1874-76, p. 277, seq.

⁵ McCook, "Honey and Occident Ants," p. 125.

Mississippi River. There appears to be no satisfactory reason (from a human standpoint) why these insects should not have pushed eastward much further; but some cause (quite satisfactory from an emmet standpoint) seems to have marked their bounds in the very midst of the great plains. So also the Cutting ants are—fortunately for the agriculturists—even more sharply limited to the southwest; and within the same geographical province, but with a little more elastic margin, to which the Honey ants (*Myrmecocystus melliger*) are confined. Not to multiply examples it thus appears that the question of importing and domesticating beneficial emmet insecticides is conditioned and may be prevented by the creatures' peculiar organism. The Chinese tree-ants are apparently natives of the South, the province of Canton, and it does not appear from Dr. Magowan's paper whether they have been also utilized in the northern provinces. Their domestication in our Southern States would, therefore, be favored by similar climatic conditions. Independent of such considerations, there are always natural checks and helps to the increase of insects, often of a nature so extremely complicated with other species of animal-life and the plant-world, either hostile or friendly, that experiment alone can positively determine such a result.

In answer to the question, "Could ants be transported so far with a view to trying the experiment?" I would say that I think the matter practicable. I brought several artificial colonies of Honey ants from Colorado to Philadelphia, carrying them in glass jars, feeding them a little water and sugar. These were kept during the fall and winter, but as the purpose was only to observe their habits, no effort was made to domesticate them. Large numbers of workers of the Agricultural ants were sent to me from Texas through the mails, arriving in good condition, and living throughout the winter. They were not permitted to live longer, as I did not consider myself at liberty to introduce, for other than mere experimental purposes, any insect that might possibly become injurious. Similar attempts to obtain colonies of the Cutting ants, all failed, these insects evidently not having the same vital power, at least for such conditions as a tin box and a mail-bag, as the agriculturals.

Shipments of ants from China I believe could be made, by placing workers, larvæ, eggs, and, if possible, a queen, in roomy boxes containing portions of their nests, perhaps also a little soil,

and covered with close wire-cloth. They should be fed, not too freely, with animal fats and sugar, and given water in a sponge, soaked cork, or cloth. With care there seems to be no reason why such artificial formicaries should not be safely transported from China.

In conclusion I wish to say that whatever benefits the ant may be led by domestication to confer upon man, she already is entitled to consideration as a valuable, if not valued, friend of the race. I have elsewhere shown¹ that ants fill an important place in the economy of Nature by contributing to the fertilization of the earth. In the paper referred to it appears from measurements of the amount of soil actually excavated, that insignificant in size as these insects are, the labors of countless hosts through many years are by no means insignificant in the shifting of the soil. They pulverize the ground and bring it in great quantities to the surface, thus making good topsoil for the growth of vegetation. In addition to this it is shown that the ants bring about the aëration of the soil, so needful for its productiveness. Moreover, the system of "pores" established by the galleries which everywhere perforate the ground, affords, on the one hand, free entrance for the rains into the earth, and on the other hand a series of tubes through which, by capillary attraction, the moisture may ascend to the roots of the plants. The last work of Dr. Charles Darwin² is devoted largely to similar habits on the part of the earth-worm; and in view of the interest which that subject has elicited, I venture to again call attention to the distinguished service wrought for the benefit of agriculture by the industrious ant. Even if that insect should not be as tractable for domestication as her Hymenopterous ally, the bee, and in spite of her occasional forays upon our cupboards and crops, the ant is worthy to stand at the head of insects beneficial to man.

N. B.—Since the above was in press I have observed that Dr. Forel, in his "Etudes Myrmécologiques" for 1879, speaks of a Mexican species of *Camponotus* (*C. senex*), in the collection of Saussure, as bearing a label inscribed "Nids de papier dans les branches"—Nests of paper in the branches. This and *Pachycondyla montezumia* make two known North American species of Tree-ants.

¹ Proc. Acad. Nat. Sciences, 1879, p. 158, seq.

² The Formation of Vegetable Mould through the Action of Earth-worms, 1882.